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CEREAL BASED FUNCTIONAL BEVERAGES: A REVIEW

Cheryl G. Fernandes[1], *Sachin K. Sonawane*[2], *Arya S. S.*[1*]

Address(es):
[1]Food Engineering and Technology Department, Institute of Chemical Technology, NM Parekh Marg, Matunga, Mumbai, India.
[2]Food Science and Technology, School of Biotechnology and Bioinformatics, D. Y. Patil University, Navi Mumbai, India.

*Corresponding author: shalu.ghodke@gmail.com

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ABSTRACT

Whole grains may be processed efficiently and innovatively to create products that would be considered as healthy. A multigrain functional beverage using whole grains like barley, oats, buckwheat and red rice can be prepared. Multigrains that contain whole grains are rich in vitamins B. complex carbohydrates (starch and fiber), and minerals. The complex carbohydrates, specifically soluble fiber, help in the slow and sustained release of energy whereas the B-vitamins and minerals facilitate metabolism. Whole grains are also plentiful in phenolic compounds which have antioxidant capacities. This review deals with the application of different cereals used in the preparation of beverages.

Keywords: Cereals, hydrocolloids, bioactives, multigrain beverages, fermented beverages

INTRODUCTION

There is a growing interest seen among consumers towards more health conscious and wholesome nutrition. This desire to make food as medicine has created a demand for foods with health benefits also known as functional foods. Whole grains are replete with nutrients and bioactives and there is sufficient scientific evidence that their regular consumption has positive effect on health. Processing multiple grains into a multigrain beverage can be an excellent form of a functional food. The following sections throw a light on the underlying idea of a multigrain functional beverage.

Modern lifestyles along with the changing dietary pattern have led to the increasing precedence of diseases like type 2 diabetes, coronary heart disease, cancer, periodontal disease and obesity. Wholesome foods can help to prevent and treat such problems. Nowadays, consumers view foods not only as a medium for satiety but also as a means of disease prevention and control (**Siró *et al.*, 2008**). This change in perspective over the years has opened the market to wide range of processed food products having specific health benefits. Such foods have been termed as functional foods. A simple definition of functional foods accepted by most food technologist is "foods and food components that provide a health benefit beyond basic nutrition" (**Corbo *et al.*, 2014**).

Functional foods should at least be a thorough source of the bioactive components based on which functional claims are made. Bioactives are biologically active substances present in various plant and animal foods that do not provide nutrition but have specific roles to play on physiological functioning and thus have an impact on human health. Bioactive components include dietary fibre, vitamins, minerals, carotenoids, fatty acids, prebiotics, probiotics, phytochemicals, enzymes and antioxidants. Figure 1 illustrates the different functional components or bioactives that can be incorporated in a food or beverage. It is the presence of these bioactives that produce the end effect on the consumers' health.

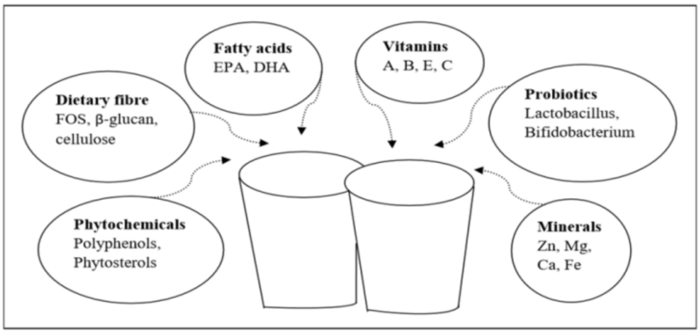

Figure 1 Illustration showing possible functional components present in a beverage

The global functional foods market size was USD 129.39 billion in 2015. The expected growth of the functional food market between 2014-2024 is given in Figure 2 (Functional Foods Market Analysis).

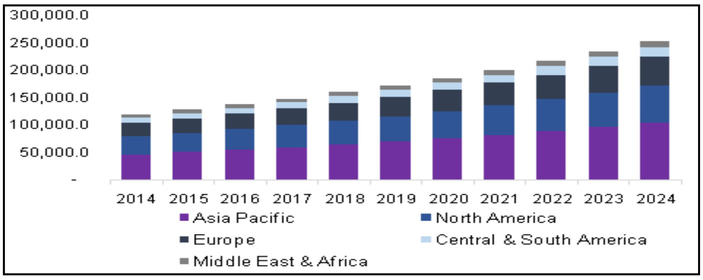

Figure 2 Region wise global functional food market share (Source: Functional Foods Market Analysis)

This shows that there is a steady increase in the global demand of functional food to which the food industry needs to cater. Products containing dietary fiber, vitamins and minerals as the major bioactives occupy largest market space. Maximum number of functional foods manufactured today are dairy based followed by the bakery and cereal based. In India, the functional food and beverage market is at its infancy and was between Rs 46 billion and Rs 49 billion in 2014-15. It was growing at 14-15 per cent (**More, 2016**).The key trends are functional yoghurt, fortified biscuits and bread, fortified breakfast cereals, fortified edible oil and functional gum. A recent trend seen in the Indian beverage market is the rapid growth of two particular sub-categories i.e., functional drinks and juices. All these statistics clearly show the need and scope of functional foods and beverages.

Beverages are the most convenient ready to consume food in the market. Heat treatment, packaging and serving of beverages is relatively easier than solid food. It is also an excellent medium for transport of nutrients and bioactives into the body as well as facilitates their easy absorption (**Wootton-Beard and Ryan, 2011**). Functional beverages are of several types. Depending on the raw materials used, functional beverages could be classified as dairy based, fruit and vegetable based, legume based, cereal based, coffee and tea. In the present study, multiple grains were selected as the primary raw material of the functional beverage.

A novel use of multigrain in the preparation of products with healthy approaches is reported by **Arya *et al.* (2013)**. The different multigrains products are developed with healthy approaches are Khakra (**Chauhan *et al*., 2017**), noodles (**Kudake *et al*., 2017, 2018; Muley *et al.*, 2015**) and multigrain thalipeeth (**Gaikwad and Arya, 2018**). Recently **Panghal *et al*.** (2018) highlights the application of fruits, cerals and legumes in the development of non dairy probiotic drink with its functional and healthy approach. Thus, the current work emphasizes on developing a functional beverage.

CEREALS AND THEIR ROLE IN HUMAN NUTRITION

Cereals are staple foods and are a major source of affordable calories throughout the world. They are available throughout the year and are rich in bioactives. Cereals have been used traditionally across the globe, especially in Asia, Africa, South America and parts of Central America. Seven major cereals consumed by humans include rice, rye, maize barley, millets sorghum, and wheat. Besides these, pseudo cereals such as buckwheat, quinoa, and amaranth also contribute significantly to the diet. Cereals and cereal products are an important source of macro and micronutrients, phytochemicals as well as antioxidants (**Mckevith, 2004**). Cereals and cereal components have the ability to impart prebiotic effects due to presence of water-soluble fiber (**Brennan and Cleary, 2005**).

HEALTH BENEFITS OF BIOACTIVES PRESENT IN CEREALS

Phenolic compounds are those having a benzene ring with one or more hydroxyl groups attached to it. They are bitter tasting compounds; present in all plant based foods and affects their color, appearance, taste and oxidative stability. In cereals, they are largely present in the pericarp and can be concentrated by removing the bran. They have antioxidant properties and hence are considered good for health as they can scavenge free radicals in the body known to cause cancers and cardiovascular diseases (**Dykes and Rooney, 2007**). The popularity of phenolics increases due to their health benefits properties antiapoptosis, antiaging, anticarcinogenic effects and bioactive capacities including antioxidant activity (**Hodzic *et al*., 2009**). Although sterol contents of cereals are lower than in oil seeds, cereals can contribute up to 40% of the daily intake of plant sterols. Plant sterols that include sitosterol, campesterol, stigmasterol, avenasterol, brassicasterols and stanols have the ability to reduce cholesterol absorption (**Valsta *et al*., 2004; Moreau *et al*., 2002**).

Vitamins and minerals are required for the proper functioning of critical biochemical pathways in the human body. They are cofactors of many enzymes and minerals also help in maintaining osmotic pressure. Vitamins B & E and minerals such as Ca, Mg, Mg, Fe, Zn are commonly found in cereals (**Hübner and Arendt, 2013**).

Dietary fiber is also a very important part of our diet. Dietary fiber is that portion of plant food that cannot be digested by human enzymes, but may be fermented in the large intestine. They are classified as insoluble fiber and soluble fiber based on their solubility in water. Soluble fiber binds with water and forms a gel network while insoluble swells in water and is capable of absorbing water upto 20 times its weight. Cereals are usually insoluble in water whereas fruits and vegetables have greater soluble fractions (**Thebaudina *et al*., 1997**). Insoluble fibers include cellulose, hemicellulose and lignins. Soluble fiber on the other hand includes pectins, gums and mucilages. A recent addition to the list of fibers is oligosaccharides such as FOS, GOS and inulin, and resistant starch.

Insoluble fiber increases the intestinal transit time, increase the bulk of faces and hence prevent constipation (**Thebaudina *et al*., 1997**). Cereal fibers appear to be more effective in increasing stool weight as compared to fruit fibers. Soluble fiber is known to affect fat metabolism by binding to cholesterol and reducing its uptake. Soluble fiber also slows down the release of glucose into the bloodstream by forming a viscous layer on the intestinal walls. It increases insulin sensitivity by lowering glycemic response. By virtue of its viscosity soluble fiber increases the gastric emptying time and provides a feeling of fullness for longer duration (**Anderson *et al.*,2009**).

Resistant starch is that fraction of starch, which escapes digestion in the small intestine, and may be digested in the large intestine (**Sajilata *et al*., 2006**). Multiple studies have revealed that it has physiological functions bear semblance to that both insoluble and soluble fiber in varying degrees (**Weisenberger, 2012**). Dietary fiber, especially the oligosaccharides serve as excellent prebiotics. They promote the growth of beneficial microorganisms namely, *bifidiobacteria* and *lactobacilli*. They improve health of the gut by lowering the pH, reduction of potentially harmful bacteria, producing vitamins, detoxifying potential carcinogens and activating health promoting compounds. Several studies suggest that regular consumption of dietary fiber reduces the incidence of colon cancer (**Anderson *et al.*,2009**).

HISTORY OF CEREAL BASED BEVERAGES

Homo sapiens are said to have appeared 2,00,000 to 1,00,000 years ago. The only beverages consumed by them were water and breast milk. Only about 11,000 years did other beverages such as animal milk, beer, tea, coffee and more recently soft drinks and fruit drinks have entered our diet. Substantial archaeological evidence suggests beer production and consumption between 4000 to 3500 BCE. Simultaneously, distilled alcoholic beverages also were developed. Credit has been given to the Sumerians and Egyptians to be the first brewers (**Wolf *et al*., 2008**). Domestication of crops was instrumental in beer making. The inclusion of cereals in the human diet is considered as an important step in human evolution as turning grains into staples required exceptional technical and culinary skills (**Harmon, 2009**).

Table 1 Traditional fermented cereal based beverages (**Altay et al., 2013; Solange *et al*., 2014; Elaine Marshall, 2012; Kumari *et al*., 2016**)

Name	Description	Place
Africa		
Borde	Beverage made from maize, sorghum, wheat, finger millet and barley by fermentation	Ethiopia
Bushera	Beverage based on germinated and fermented sorghum or millet	Uganda
Gowé	Fermented beverage based on sorghum or maize or millet	Benin
Kunan-Zaki	Beverage made from maize or millet	Nigeria
Mahewu	Fermented maize meal and wheat flour based beverage	South Africa
Obiolor	Beverage made from sorghum and millet	Nigeria
Togwa	Maize flour and finger millet malt fermented beverage	Eastern Africa
Mahewu	Fermented maize meal and wheat flour based beverage	South Africa
South America		
Acupe	Germinated, fermented and sweetened maize beverage	Venezuela
Agua-agria	Non alcoholic beverage based on ground maize and water	Mexico
Cachiri	Fermented beverage based on maize, made in clay pots	Brazil
Champuz	Fermented beverage from maize or rice	Colombia, Peru
Fubá	Beverage made from germinated and fermented maize grains	Brazil
Napú	Beverage based on germinated,ground and fermented maize	Peru
Pozol	Acidic beverage based on maize liquor. Balls prepared from fermented dough are enveloped in banana leaves	Mexico
Europe and Asia		
Boza	Fermented malt drink made from maize, millet, wheat or barley. Has thick consistency with slight acidic, sweet flavour.	Kazakhstan, Bulgaria, Albania, Turkey and Romania
Ambil	Beverage made from fermented ragi flour, cooked rice and buttermilk.	India
Kali	Fermented cooked rice beverage	India

Poor water quality was one of the leading factors for man's quest for newer beverages. Fermentation was thus employed in making various beverages primarily for their safety (**Altay et al., 2013**). Fermented alcoholic and non-alcoholic beverages were being made in the medieval ages. Table 1 enlists various traditional non-achoholic beverages made from fermented grains with their country of origin. Most of the grain based non-alcoholic beverages have been produced in the African and South American continents (Table 1). Some of the traditional non-alcoholic African traditional beverages include Bushera made from sorgum or millet, Kunan-Zaki made from sorghum, Mahewu made from maize, Gowé made from millets, Obiolor made from sorghum and millet and Borde made from maize, finger millet, wheat, sorghum and barley. The latter two beverages are made of multiple grains (**Solange *et al*., 2014**). Fermented non-alcoholic beverages from South America include Pozol, Agua-agria, Napú, Fubá, Acupe and Champuz. They are predominantly made from maize (**Elaine Marshall, 2012**). Ambil and Kali are traditional fermented beverages from India. The former is made from finger millet and latter from cooked rice. Ambil is fermented using sour buttermilk (**Kumari *et al*., 2016**).
More recently, in the last 200 years, beverages mixes made of malted grains came into being. They were meant to be consumed with milk to increase its wholesomeness and for palatability. The first malt powder was developed by William Horlick in the 1870's. In 1882, he mastered the process of drying milk alongside malt and wheat, thus making a product readily soluble in water. Doctors recommended Horlick's food to their patients (**Perry, 1990**).

CHARACTERISTICS OF GRAINS

Barley

Barley (*Hordeum vulgare* L.) is an important ancient cereal crop, first domesticated in the the Israel-Jordan region. It has been an important food source in the Middle East, northern Africa, parts of Europe and Asia. Initially, barley had been cultivated as a food crop. But as wheat was introduced and took over as a staple human food, barley was used primarily as animal fodder and for malting purposes (Sharma and Kotari, 2017). Barley grains are known to have nutraceutical properties and hence there has been a renewed interest to incorporate it in foods and exploit its benefits. Specifically, beta glucan and phenolic compounds present in barley are effective against certain health conditions like cardiovascular diseases and diabetes (**Behall *et al*., 2004; Cavallero *et al*., 2002**).
The use of barley as food declined during the 19th and 20th centuries due to the greater acceptability of rice and wheat products. With increasing scientific knowledge of the health benefits of barley seeds, especially its beta glucan, efforts have been made to improve food processing techniques to incorporate them in various foods (wheat based products noodles, cookies and extruded snack) (**Newman and Newman, 2006**). The Western countries use pearled barley, whole, flaked or ground in breakfast cereals, porridge, soups, stews, baby foods and bakery flour blends. In Middle Eastern and North African countries, ground pearled barley is used to make flat bread, soups and porridge (**Bhatty, 1993**).

Oats

A whole grain which has been gaining prominence over recent times is Oats (*Avena sativa L.*). It is particularly high in soluble fiber, β-glucan, protein, lipids and specific micronutrients, as well as appears as a unique source of polyphenols known as avenanthramides (Singh *et al*., 2013). Various processed forms of oats are found today which facilitate faster cooking and easier consumption. Initially, the oat grains are dehulled and scoured to obtain oat groats which are then kilned and ground, kilned, steamed and cut, or kilned, steamed and flaked to get oat flour, steel-cut oats and flaked oats respectively. Depending on the thickness of the flakes, flaked oats are further divided into rolled oats, quick oats and instant oats (Webster and Wood, 2011). A simplified flowchart of oats processing is shown in figure 3. The main component of oat is starch and its content depends on the variety and growing conditions. Dehulled oat groats contain 15-17% protein, 59-70% sugars and starches, ~ 4.5% fat, 2-6% b-glucan and ~12% dietary fiber (**Usman *et al*., 2010**).

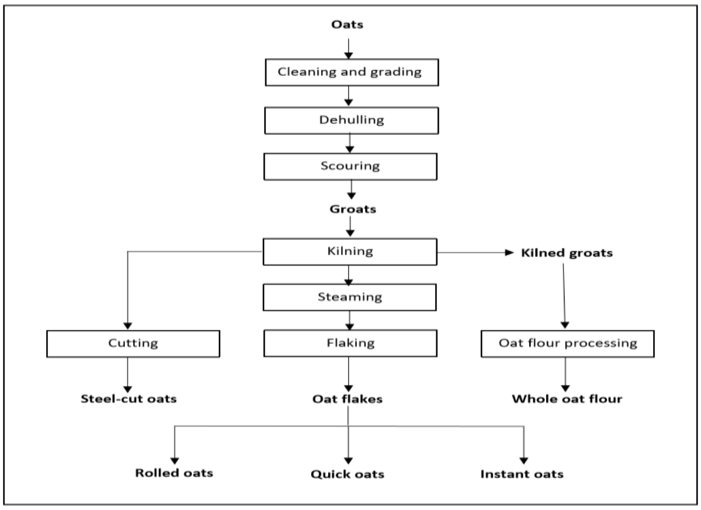

Figure 3 Oat grain processing flowchart (adapted from **Webster and Wood, 2011**)

Dong et al. (2015) reported an anti-obesity effect of oat dietary fiber on high-fat diet-induced obese mice. The fasting serum insulin level declined significantly ($P<0.05$) compared with model group, meanwhile, and the thyroid stimulating hormone level significantly increased ($P<0.05$), and soluble dietary fiber was more effective ($P<0.05$).

Buckwheat

Buckwheat (*Fagopyrum esculentum*) is a pseudo cereal, origin of central and eastern European countries, and highly nutritious (**Bonafaccia *et al*., 2003**). In literature, the protein content (12% to 18.9%) of buckwheat grains has been reported. Starch content varies from 59-70%, lipids vary from 1.5-4% and total dietary fiber is around 7% of the dry mass (**Christa and Soral-Śmietana, 2008**). **Lu et al. (2013)** observed significant genetic variation in buckwheat groats for 1,000-kernel weight (16.5-39.8 g). The variation found is given for the following components: total phenolic content (6.8-20.7 mg of GA/g), free phenolic (4.5-17.1 mg of GA/g), total dietary fiber (3.6-10.6%), insoluble dietary fiber (2.3-8.6%), and soluble dietary fiber (1.4-3.4%). Anti-inflammatory effects were attributed to the major bioactive phenolic, namely rutin and quercetin present in tartary buckwheat (**Lee *et al*., 2013**). Buckwheat powdered sprouts (PSs) has the highest γ – amino butyric acid (GABA) and rutin among the powdered sprouts having values of 144.7mg/100g and 768.6mg/100g respectively. Rutin-enriched buckwheat PSs significantly decreased triglycerides on day 23 of a 46 day study on SRHs (**Nakamura et al., 2015**). **Wefers and Bunzel** (2015) found large amounts of pectic polysaccharides in both buckwheat insoluble and soluble fiber.

Red Rice

Rice (*Oryza sativa L.*) is the chief dietary source of carbohydrates consumed by nearly one-half of the world population. There are more than 5000 varieties of rice available in the world differing in their biochemical, physical, milling and cooking qualities (**Bhattacharjee *et al*., 2002**). Among these there is a distinct group of pigmented rice which is mainly red, black and dark purple rice. Anthocyanins are the major functional components of color rice. Besides this, they contain a variety of flavones, phenolic, tannin, tocopherols, sterols, γ-oryzanols, amino acids, and essential oils (**Yawadio *et al*., 2007**). Red rice is characterized by the presence of proanthocyanidins, whereas in black rice both anthocyanins and proanthocyanidins can be present, depending on the variety (**Finocchiaro *et al*., 2010**). Besides providing color, these components deliver protective antioxidant and anti-carcinogenic activities, which help in diabetes, cardiovascular disease, and cancer prevention. According to several studies, red rice has 10 times the antioxidants of brown rice. Red rice is also mineral dense with 20 percent of the daily values for phosphorus, magnesium, and molybdenum. Red rice is known to have a pleasant nutty flavor (**Ornish Living, 2017**). **Zaupa et al. (2015)** characterized the total antioxidant capacity and (poly) phenolic compounds of differently pigmented rice varieties and their changes during domestic cooking Total phenolic acids of raw and boiled red rice were found to be 36mg/g and 26mg/g respectively. Total antioxidant capacity of raw and boiled red rice was found to be 43.63 mmol/kg and 20.17 mmol/kg respectively.

NON-DAIRY PROBIOTIC DRINKS UTILIZING SPROUTED CEREALS, LEGUME AND SOYMILK

A non-dairy probiotic drink using sprouted cereals, legumes and soymilk was developed by **Mridula and Sharma (2014)**. Sprouted grain flours of wheat, barley, pearl millet and green gram were independently used to make probiotic drinks. The grains and green gram were soaked and then were sprouted individually. Then they were dried and milled. Then optimized amount of flours mixed with soymilk and water were fermented by *Lactobacillus acidophilus*-NCDC14 for 8 hours. Along with these optimized amount of flours, other ingredients viz. oat, guar gum, sugar, and cardamom. All the samples were evaluated against two controls i.e. one without soymilk and other without soymilk and sugar for probiotic counts. In general, for all types of probiotic drinks, the probiotic count increased on addition of soymilk and sugar. It also increased with increasing grain flour concentration. Thus these concentrations of cereals are recommended to prepare sensory acceptable probiotic drinks. Their work has been summarized in Table 2.

Table 2 Non-dairy probiotic drinks utilizing sprouted cereals, legume and soymilk **(Mridula and Sharma, 2014)**

Constituents of Beverage	Functional Properties & Health Benefits	Chemical Properties	Process/Technology
Probiotic drink made of wheat/barley/pearl milllet/ green gram with soymilk, oats (6%) and sugar (7%) *Lactobacillus acidophilus*-NCDC14	9.10-11.51 log cfu/ml Improves intestinal microbial balance	pH: 4.1-4.5 It decreases with increasing concentration of substrate Sensory score was acceptable (≥ 7) for up to 6% of wheat, barley and gram and up to 4% of pearl millet	Soaking (8h, 30°C) Sprouting (36h,24h) Drying (50°C, 8-9% moisture) Milling (~0.177mm) Fermentation (1%(v/v), 48h)

Tejate: A maize-cacao beverage

Tejate is a Mesoamerican drink prepared from maize and cocoa. The maize is nixtamalized using wood ashes traditionally. Commercially nixtamilization is done using lime. **Amaro et al. (2015)** studied the effect of different types of maize varieties on the nutritional quality of tejate. Tejate was prepared by mixing 3 kg of cuanextle-masa with 200 g of cacao-masa and pouring 10 L of iced water to it to obtain a foam-topped beverage. Cuanextle-masa is prepared by cooking 100 g maize together with 75 g wood ashes in 2 L of water at 90°C for 45 minutes, followed by rinsing, draining and coarse grinding. Cacao-masa is made by fine grinding 180 g cacao beans, 20 g rosita blossom and 10 mamey seeds which have been toasted on a hot plate for 5-10 minutes (Table 3).

Table 3 Tejate: A maize-cacao beverage

Constituents of Beverage	Functional Properties & Health Benefits	Chemical Properties	Process/Technology
Tejate (Mesoamerican drink) Maize (30%) Cacao (6%)	GI (in vivo): 25.02-32.71 Helps maintain normal post-prandial glucose response Provides essential micronutrients	Important source of Cu, Mg, Fe, Zn & P that met daily intake recommended values (WHO/FAO 1998) Resistant starch (RS) 0.81 % for tejapayam 2.43 % for Bolitatejate Starch-lipid complexes (type 5 RS) formed during annealing and gelatinization	Ash nixtamalization Grinding to make masa Blending with water

Tejate made by the process of ash nixtamilization had higher content of minerals (Ca, Fe, Zn, K, Mg & P), dietary fibre and resistant starch as compared to commercially available tejate called Tejayapam. Among the local maize varieties, tejate made from White Bolita maize had the highest mineral and resistant starch content. Its properties were comparable with a commercially sold maize variety Cacahuacintle. The type 5 resistant starch present is due to the starch-lipid complexes formed during gelatinization and annealing. According to the in vitro GI studies conducted by the authors, tejate without added sugar has GI ranging from 25.02-32.71 and should be recommended to maintain the normal post-prandial blood glucose responses.

Functional emmer beverages

In this study the physical, chemical, functional, and sensory properties of non-alcoholic emmer beverages fermented with selected autochthonous lactic acid bacteria were characterized (**Coda et al., 2011**). Emmer flour, gelatinized emmer flour and emmer malt were used as substrates in the concentrations 5, 10, 15 % for emmer malt and flour and 5, 10, 15 and 30% for gelatinized emmer flour. Based on the sensory analysis conducted and considering 7.0 as the optimal score, beverages F15, GF10, GF30 and M5 (where F, GF and M stand for flour, gelatinized flour and malt respectively) were selected for further analyses. The substrates were inoculated with *L. plantarum* 6E (initial cell density of ca. 5× 10^7cfu/ml) to make fermented beverages. *L. plantarum* 6E and *L. rhamnosus*SP1 were used to make a probiotic beverage from gelatinized emmer flour at 30%. *Weisellacibaria*WC9 can be used if further thickening of beverages is desired as it secretes an exopolysaccharide thus increasing the viscosity of the beverage. Pasteurization was carried out for all the beverages prepared except for probiotic beverage. The paper has been summarized in Table 4.

Table 4 Functional emmer beverages (**Coda et al., 2011**)

Constituents of Beverage	Functional Properties & Health Benefits	Chemical Properties	Process/Technology
Emmer flour, Emmer gelatinized flour, Emmer malt (5-30%) *L. plantarum* 6E, *L. rhamnosus*SP1, *Weisellacibaria*WC9	Dietary fibre - regulates the energy intake and satiety Polyphenols- antioxidant and anti-inflammatory properties Phytase activity comparable to sourdough	pH: 3.95-3.99 TA: 1.0-8.6 ml of 0.1 M NaOH/10g Only beverage made with gelatinized flour contained acetoin which imparted creamy flavor	Malting Gelatinization Fermentation (4h, 30°C) Centrifugation Pasteurization (30 min, 63°C) Viscosity: 1.35-30.5 mPa s Storage at 4°C for 30 days

Haria - a rice based fermented beverage

Haria is a rice-based fermented beverage made out of low grade boiled rice (*Oryza sativa* L.), belongs to West Bengal and East-Central India. Haria is known to have many health benefits. The properties and processing of Haria have been given in Table 2.5. **Ghosh et al. (2014)** investigated the ethno botanical importance and traditional process of haria preparation. The study was based on interactive questionnaires and laboratory experiments. Such studies can help in exploring traditional cereal based beverages and their functional properties [Table 5].

Table 5 Haria - rice based fermented beverage (**Ghosh et al. 2014**)

Constituents of Beverage	Functional Properties & Health Benefits	Chemical Properties	Process/Technology
Low grade boiled rice (*Oryza sativa L.)* Starter culture – bakhar *Cissampelos pareira L. roots, Diospyros melanoxylonRoxb. bark & leaves, Lygodiumsmithianum C. Presl. whole plants, Orthosiphon rubicundus (D.Don) Benth. tubers, Ruelliatuberosa L. tubers, bark, and roots, and bark of Terminalia alata Roth*	Can protect them from many gastrointestinal ailments, particulary dysentery, diarrhea, amebiosis, acidity, and vomiting Also, native physicians claim it as a skin, eye, hair, and heart protective agent.	Contains terpene glycosides, chalchone glycosides, flavanones , lycopenes, carotenoids, tocopherols, saponins, flavonoids. Titratable acidity:1.42% pH 3.61 Ethanol content: 2-3% (v/v)	Fermentation in earthen pot for 3-4 days. Diluted with water and filtered using fine cloth

Cereal Milks

Plant-based milks or non-dairy milks are gaining much importance as a functional and specialty beverage across the globe. They serve as an alternative to cow's milk in a period in which lactose intolerance, cow milk allergy, calorie concern and hypercholesterolemia are prevalent. Added to this there has been a growing preference to vegan diets as well. They are also economical substitutes, where cow's milk is expensive or insufficient (**Valencia-Flores, *et al*., 2013**). A major challenge faced by cereal milks and plant-based milks in general is that they are not as nutritionally balanced as bovine and face technological challenges related to processing and preservation. Nevertheless, the functionally active components they contain and the health benefits they confer make them an attractive option. Plant-based milk alternatives are liquids that are a result of size reduction of plant material namely cereals, pseudo-cereals, legumes oilseeds and nuts, extracted in water and further homogenized to obtain a particle size distribution in range of 5–20 lm which imitates cow's milk in consistency and appearance (**Sethi and Rahul, 2016**). Optionally, small quantities of vegetable oils may be added before homogenization to increase the lipid content. Plant-based milks may be classified into the following five categories: (a) Cereal based, (b) Legume based, (c) Nut based, (d) Seed based and (e) Pseudo cereal based. The cereal milks that have been experimented thus far are oat milk, rice milk, spelt milk and corn milk. The quinoa milk, amaranth milk, and Teff milk were reported in the pseudo cereal category (**Sethi and Rahul, 2016**).

CONCLUSION

Multigrain beverages have a fine scope of being functional drinks by combining the goodness of whole grains in a liquid medium. By using multiple grains, various bioactive components get summed up in the final product and certain undesirable traits also get masked. The grains selected for the preparation of multigrain beverage in the present study are barley, oats, buckwheat and red rice. The grains were selected according to their high soluble fiber and phenolic content. The presence of soluble fiber lowers the glycemic index of the beverage by slowing down its digestion and absorption, whereas phenolic compounds have antioxidant potential and scavenge the harmful free radicals in the body. In view of the work done by various researchers on cereal based beverages, it can be concluded that there are several methods that can be followed for beverage preparation and a combination of grains may be used. The beverages are primarily made with water, though milk may be used as well. Besides these, additives may be added to improve the overall quality of the beverage. The processing steps could include soaking, sprouting, malting, cooking, grinding and filtering in any suitable order. To make a fermented beverage or prebiotic, fermentation would be necessary. For non-fermented beverages, enzyme treatment may be done as well.

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